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by V. V. Parin

- USSR -

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## THE BIRTH OF COSMIC BIOLOGY

- USSR -

Following is a translation of an article by V. V. Parin in the Russian-language periodical Priroda (Nature), Vol. LI, No. 10, Moscow, 1962, pages 9-11.

11-15 August 1962. On those days the whole world followed the remarkable victory of Soviet science with bated breath: the Soviet cosmic sputniks "Vostok-3" and "Vostok-4" with the new cosmonauts, A. G. Nikolayev and P. R. Popovich flew swiftly about the earth in cosmic space. All the details of this first group cosmic flight in history, "Sokol" and "Berkut" have been imprinted forever in the memories of many millions of inhabitants on our planet. In connection with this remarkable cosmic duet it is desired to recall the short, but glorious path of Soviet cosmic biology and medicine, which has naturally led to the new triumph of Soviet science, of which we have been witnesses.

Cosmic biology, which is being created at the present time, had its beginning in 1949, that is, a little more than ten years ago, with the vertical flights to a height of 100 to 400 kilometers of geophysical rockets with dogs situated in special cabins in the nose part of the rockets. The basic conclusions from this series of experiments (32 dogs) gave the following data: the animals satisfactorily endured the conditions of acceleration present in the flight of rockets; they also satisfactorily endured the short (up to six minutes) periods of weightlessness; it turned out possible to work out methods of returning the animals to the earth in the parachute nose cones of the rockets and also in individual parachutes catapulted from the cabins; and, finally, the absence of any kind of unfavorable after-effects of the flights was made known. The next step was the experiment with Laika in the second Soviet man-made earth satellite (3 Nov 1957), which proved the possibility of existence of animals in the conditions of weightlessness in the course of three days.

In 1960 and 1961 biological experiments were conducted in the second, third, fourth, and fifth Soviet cosmic space-ships.

The biological objects applied in these experiments were highly varied: dogs, the names of which: Belka, Strelka, Zvezdochka, Chernushka — will be remembered for a long time; rats, mice, guinea pigs, frogs, fruit flies, higher plants (*Tradescantia*), dry seeds, (wheat, peas, onion, corn, fennel-flower (*Nigella*)) and sprouts of plants in various stages of growth, snails, unicellular water-plants, (*Chlorella* — algae), cultures of human tissue and rabbits, skin transplants, bacterial cultures, viruses, preparations of cellular kernels and cytoplasm of cells, fermentations and several biochemical substances. It was not in vain that popular discussion christened these ships flying "Noah's Arks" of the XX century!

A wide comparative-biological approach allowed for a comprehensive evaluation of the effect of the factors of cosmic flight on living organisms and gave the basis of a responsible conclusion on the possibilities and opportuneness of cosmic flight for man. Therefore during the last biological experiments with cosmic trips of animals work had already begun on the selection and comprehensive preparation of human cosmonauts.

The pilots Yu. A. Gagarin and G. S. Titov were chosen to accomplish the first flights. The flights of the cosmonauts followed routes which had already been tested during the flights of the cosmic ships with animals on board. In this way, the first cosmic flights of man had been undertaken in the order of a logical sequence, when each new step was naturally a result of its predecessor.

The system of providing living conditions on the space ships "Vostok" was worked out in the numerous laboratory experiments and then approbated in practice in a series of flight biological experiments with animals. Also all the methods of radio-telemetry which in the future allowed for an exact and objective tracking of the conditions of health of the human cosmonauts were verified preliminarily in the real conditions of cosmic flight.

The careful pre-flight preparation of the cosmonauts, the most particular examination of all the parts of the instruments connected with providing living conditions within the hermetically sealed cabin of the cosmic ship, gave their fruits. Before the start of all the sections of the trajectory of flight and after it the well being of Yu. A. Gagarin was completely satisfactory. His attention was attracted to the exceptional steadiness of character, tranquility, even-temperedness, control and adequateness of reactions.

All the changes in the physiological indices during the active part of the flight were within admissible limits. The cosmonaut maintained radio communications with earth, successfully accomplishing his mission. Yu. A. Gagarin noticed some unusual sensations in the conditions of weightlessness, however normal body functions were not upset. Yu. A. Gagarin successfully endured the transfers connected with the braking of the space ship during the descent and landing.

To be concise, a scientific analysis of the pilot Yu. A. Gagarin showed the safe conditions for man in a short (upto 100 minutes)

cosmic trip. This permitted an increase of the duration of flight of the next cosmonaut — G. S. Titov — to twenty-four hours. In connection with the greater duration of the flight of G. S. Titov, it was considered necessary to increase slightly the number of objective methods of keeping track of the condition of the cosmonaut in flight.

Changes in pulse and breathing in cosmonaut No. 2 while in orbit and in descending did not differ essentially from the data during training and during the flight of Yu. A. Gagarin. In the conditions of orbital flight the indices of the frequency of the pulse and breathing, on the average, approximated the initial values prior to starting. The well being in flight, on the whole, was satisfactory. The cosmonaut completely accomplished his flight task, maintaining radio communications with earth, controlling the operations, connected with the orientation of the space ship, film survey and other aspects of activity. No significant disorder in the coordination of movements was noted. Along with the transfer to the condition of weightlessness G. S. Titov sensed a short illusion of being "upside down". Then as long as the condition of weightlessness continued, unpleasant sensations appeared and became stronger, such as those commonly associated with the appearance of sea-sickness (dizziness, nausea). These manifestations became stronger with sharp movements of the head, decreased and almost disappeared in those cases, when G. S. Titov limited these movements and assumed the initial position. They significantly slackened after sleep and completely disappeared after the beginning the movement of shifting while the space ship was returning to earth.

The basic scientific results of G. S. Titov's flight are proofs of the complete possibility of remaining in cosmic space in the course of a twenty-four period without interrupting the operating capabilities and the normal state of the basic physiological functions.

After Yu. A. Gagarin's and G. S. Titov's flights the Soviet scholars and designers did much work, directed toward increasing the stability of man to the effect of the factors of cosmic flight and toward the preparation of conditions for a longer period for man to stay in the cabin of cosmic ship in flight. The sensations resembling sea-sickness felt by G.S. Titov forced us to give special attention to the methods of analyzing the vestibular reactions, and also to the training of vestibular and motion analyzers. The purposeful system worked for these tasks completely proved itself: the stability of the cosmonauts to the varied types of acceleration was increased significantly. A. G. Nikolayev spent 95 hours in the cosmos without hardly any unpleasant subjective sensations. P. R. Popovich — 71 hours. The most detailed analysis of the objective indices of the activities of the cardiovascular, respiratory, nervous system, and of the emotional sphere also revealed no dangerous deviations from the norm even for a short while.

The flights of A. G. Nikolayev and P. R. Popovich differed from the

flights of Yu. A. Gagarin and G. S. Titov not only in the longer length of time spent in space. Many changes were introduced into the program of the behaviour of the cosmonauts in flight. One of the most important changes was the task to loosen oneself from the chair and freely move about the cabin in the state of weightlessness. The accomplishment of this point of the program illustrated the complete control of the coordination of muscular movements including delicate movements and good orientation in space.

Still another innovation in the flights of "Sokol" and "Berkut" must be emphasized: both of them were fed food packed in plastic packets and prepared according to the usual culinary rules on earth.

A. G. Nikolayev's and P. R. Popovich's cosmic trip produced a great abundance of scientific material. All the radio-telemetric curves received are deciphered and carefully studied. In the course of this study many interesting and valuable conclusions will be found.

The short survey made of the basic stages of the development of Soviet cosmic physiology reveals one especially characteristic trait of this research. It is the strict sequence of the separate stages, the real ladder of science, each step lifting knowledge to a new height. From the vertical flights of rockets with dogs to the experiment with Layka in the sputnik that did not return to earth, and to the biological experiments with space ships that did return, this ladder led to the 108-minute flight of Yu. A. Gagarin, then to the 24-hour trip of G. S. Titov and, finally, to the three and four day cosmic trips of P. R. Popovich and A. G. Nikolayev.

Not one of the flights of the ships with a "human" crew was a simple repetition of the previous flights. Each time new tasks were added and accomplished on the basis of the one already achieved by science. The succession of the separate stages provided for the continuity of the offensive impulse of Soviet science. This causes us to look to the future with certainty, to see the successful overcoming of the difficulties, which arise with the complications of the tasks of cosmic biology, to keep up the struggle for keeping Soviet science in the advanced guard position of mastering cosmic space.